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ABSTRACT

It is especially important that teachers working in classrooms in rural areas of developing countries select instructional technologies that are appropriate, pedagogically sound, innovative, cost-effective, and manageable. When selecting the instructional media that will be used in a particular classroom situation, teachers should remember that the formal classroom is a social system in and of itself. Although media can never be a substitute for good two-way communication between teacher and student, it can enhance the teaching-learning process and is particularly valuable as a tool for reaching learners who are widely dispersed over vast geographical areas. Numerous research studies have evaluated the pros and cons of radio, tape-slide presentation, peer tutoring, and media and classroom ethos. Radiovision appears especially promising as an instructional medium in developing nations. Radiovision is an instructional system in which subject matter is presented through both audio and visual channels. It is a system in which students look at visuals that are presented on the screen through slide projectors, filmstrips, charts, models, and other media, and listen to explanations via a cassette player. Compared with television, radiovision is more economical, more favorable to student viewers, more easily manipulated (in the sense that material can be more easily played back), and capable of being produced by using a combination of classroom- and commercially-developed materials. (MN)

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RESOURCE PAPER

TECHNOLOGIES TO IMPROVE IN-CLASS INSTRUCTION

DR. MOTILAL SHARMA

A SEMINAR ON

USES OF TECHNOLOGIES FOR EDUCATION AND TRAINING:
AN ECONOMIC PERSPECTIVE

(18-29 APRIL 1988)
WASHINGTON, D.C.

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DR. MOTILAL SHARMA

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TECHNOLOGIES TO IMPROVE IN-CLASS INSTRUCTION

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The battle against ignorance, waged mostly through a nation's educational and training system, is fought largely in the classroom. Yet in every poor village or rural area of developing countries, the classroom's real educational presence is represented mostly by the teacher. This Resource Paper advocates appropriate technology for use by the teacher, and by students applied to the learning process in ways that are pedagogically sound, innovative, cost-effective, and manageable. It analyzes various media and approaches and concludes that radiovision, which can be developed as a handy portable "technology at the grassroots", is a viable tool in-class for the teacher and students.

I. INTRODUCTION

1. Nothing happens to education unless it first happens in the classroom. This is the singular incontrovertible fact so often neglected or misunderstood by policymakers and administrators. It is crucial therefore to examine the micro-setting of the classroom as a starting point in any educational reform. To begin with, the classroom is an "accidental" group as far as its participants are concerned. In the majority of cases, on the first day of school when the child enters the classroom, he may find with him both friends and strangers comprising an entirely accidental social situation. They are brought together by accident of birth, residence and assignment, rather than by choice. This group is formed for the purpose of learning -- which is accomplished in a planned learning situation. What is to be learned and the means by which the learning is to be accomplished are also given. Educational subjects, methods and curricula of instruction are planned in advance by experts external to this group. Another distinctive characteristic of the classroom is that the control or leadership exercised in the classroom is vested in the teacher. The teacher, in a usual school setting, is older, more mature and presumably wiser than his students. However, the authority of the teacher can certainly be delegated to the pupils for specific functions in certain situations.

II. CLASSROOM AS A SOCIAL SYSTEM

2. The formal classroom a social system by itself. It consists of persons influencing and being influenced by one another and attracted to the same or similar concerns, goals and values. The major elements of the behavior of this social system include: (i) activity (the act which individual members perform); (ii) interaction particularly

1/ Asian Development Bank, Manila, Philippines.

interpersonal communication; and (iii) sentiments particularly interpersonal attraction (Mishra, 1979) (the positive or negative feelings which members have for one another). These elements influence student motivation and participation in classroom activities. For learning to take place, student motivation and participation in the instructional group are very important. Unless a certain minimum level of student involvement in the instructional activities of the group is reached, they experience a great deal of frustration and sense of failure. In this context, a classroom could be described as a socio-psychological instructional work-group, whose members (learners) interact with contents, classmates, peer groups, subject-teachers and other learning resources until a learning climate is generated.

3. Anyone visiting a few classrooms will quickly notice how they differ from one another in their "atmosphere". In one classroom, the teacher and the students may be zestful and carry out what they are doing with confidence. In the second classroom, the brooding may be palpable. The teacher may try to hide his incompetence and lack of a sense of direction behind the cloak of authority. The psychological sickness of such an atmosphere affects the motivation and participation of students as well as the achievement of objectives of the learning tasks. Then, there could be a third classroom which may be marked by neither joy nor despair. The level of interaction in the classroom therefore depends to a great extent on the classroom climate. Interactive group activities are the primary base of cognitive and affective behavior of students as a working group and pave the way for productive outcomes in a classroom. The classroom is the universal microcosm of any educational system -- whether in the First World or the developing nations. Yet each classroom has its distinctive climate, culture and lifestyle. Classrooms of different subjects of the same grade or standard among schools can differ from each other in their way of life. Thelan (1974) has described the classroom climate as a way of life immersed in classroom ethos. This classroom ethos has three core constructs, namely authenticity, legitimacy and productivity. Against this background of the classroom social structure, every group has to be concerned with the authenticity of its operation to the participants; each classroom has to legitimize its activity in some way or another; and every classroom has to be able to distinguish productive from nonproductive ways. In designing instructional strategies for a given classroom, all these factors need to be taken into account. Furthermore, there is yet another dimension to the classroom that has received little attention, especially among poor countries, despite the powerful potential this vital factor can bring to the learning process. I refer to the mode and media used by the teacher for influencing the instructional climate as well as the outputs of the classroom.

III. COMMUNICATION MEDIA IN THE CLASSROOM

4. Communication is defined by Edgar Dale as "the sharing of ideas and feelings in a mood of mutuality". Any media through which this message is achieved can be termed as the communication media. The

communication media can be the spoken word, or a signal, gesture, picture, visual display, print, broadcast, film -- i. e., all the signs and symbols by which humans try to convey meaning and value to one another.

5. The frequently employed channels of communication are oral and visual. There are many sources of messages for communication in the classroom. The most obvious one is, of course, the teacher. The communication in the classroom is what we refer to as "interpersonal", i.e., two-way communication between teacher and students. In addition to the teacher, books, audio-visual aids, such as films, records, tape slide, audiotapes and television can also serve as classroom sources of the message. The same content when presented differently, or with different media, will give a different quality to the message. The subtle power of these communication media in shaping the educational and social environment in general, and the teaching-learning process in particular, is now recognized. The media create a distinct classroom environment. Indeed, instructional media are making a major impact on the quality of education. There is probably no other area affecting the schools that is closer to the educational revolution than media and technology. There is of course a dividing line. Media are not a substitute for the teacher, but they are useful tools that can greatly help in improving the teaching/learning process.

6. Appropriate selection of media can make more efficient use of valuable and limited resources such as the time of teachers and students alike. By careful choice of media and reception equipment, appropriate learning experiences can be widely spread with the help of mass media backed up by effective software, and can be made available effectively to large audiences scattered over vast geographical areas as well as to small classes. For example, tape-slide materials present both visual stimuli like pictures, written symbols, graphics, as well as the auditory stimuli explaining the visuals. In using tape-slide materials, a student can proceed at his own pace. He can replay the system as many times as he wishes. Tape-slide sequences may be used in different ways for different purposes. Part of the tape or the slides can be revised with hardly any inconvenience. Thus, the teaching material can be kept continually up-to-date. Though selection of an appropriate medium of presentation is important, its effectiveness greatly depends on how the selected medium interacts with learners in the teaching-learning process. The educative climate produced in the classroom due to the interaction of learners with different characteristics plays an important role in promoting learning.

IV. INSTRUCTIONAL SYSTEM

7. Teachers are always an inspired lot, and their grandest adventure is the liberation of the learner. Therefore, using student goals and aspirations as the base, classroom instruction inevitably leads to the concept of an instructional system. An instructional system is an integrated set of methods, media, equipment and personnel

(mostly the classroom teacher) performing efficiently the functions required to accomplish one or more teaching (instruction) objectives. The presentation and practice of knowledge of the system are governed by the performance requirements and activities needed by the student. In view of these conditions, a given course content has a structure to it, possessing definite boundaries. There are important concepts to be covered. They are dealt with in a certain sequence; and varying amounts of time will be spent on them, depending on their importance. The teacher is an important element in this dimension, and so are his teaching methods and media. Interaction takes place between the core elements of curriculum, namely: (i) teaching methods; (ii) media; (iii) learning materials; (iv) learning space; and (v) learners, according to the nature of the subject being taught. Systems approach (Sharma: 1978, 1985), attempts to increase the teacher's efficiency by specifying the instructional objectives with precision, and by redesigning the entire teaching-learning process, based on finer analysis of all elements of the instructional system, to ensure student attainment of specified objectives and measurements.

8. The developments in instructional technology bring with them an increasing need for systematic planning and presentation of curriculum in the classroom. Similarly, to maintain an effective classroom climate, the teacher needs to arrange the learning situations in such a way that new problems are presented one at a time, and each "new skill" mastered before a more advanced skill is taught. This contributes to instructional effectiveness. Furthermore, in using the systems approach to instruction, methods-and-materials decisions are important in the determination of units of study, instructional packages, and mode of teaching. The factors which influence the methods-and-materials decision are: the nature of content, the type of learners in a given classroom, the teacher's competence, and the resources made available.

9. Different writers have used terms like "medium", "mode", "learning resource", "hardware", "software", and so on interchangeably, without always making clear what they were referring to but nevertheless often contradicting one another's usage. For the purpose of this paper, we can broadly distinguish the meaning of the terms, "mode" and "medium" by saying that "mode" is the kind of stimulus presented to the student. Thus, written symbols represent one mode, pictures another. The vehicle carrying the stimulus mode is called medium. There are usually a variety of media available for presenting any given stimulus mode, e.g., books, films, radio, and TV. Finally, a "learning resource" is any combination of stimulus mode and presentation medium with a message for a target group of students. Thus, a piece of hardware is a learning resource only if accompanied by appropriate high quality software. To illustrate, the tape recorder is hardware, the programmed tape is a piece of software. In this case, audio-tape is the medium, and the stimulus mode used is recorded sound. Most of our stimulus modes can be used, separately or together, in a variety of presentation media and the same is true for media.

10. Multimodal, multimedia approach can answer many of our problems related to teaching-learning. Decisions on stimulus modes and presentation media are, to a great extent, determined by the objectives of instruction. As a word of advice, however, one should not overemphasize the importance of the stimulus mode as the only factor influencing learning. General environmental factors such as adequacy of diet, sleep, fresh air, exercise and affection (in terms of interpersonal attraction, as for example, student-teacher, children-parents and among peers), also help influence learning on the part of a learner and, if properly managed, could greatly facilitate learning. Besides, the intensity of the interaction -- the degree to which each person modulates his behavior in the light of responses from others in the classroom group -- will vary from one presentation medium to another. Although many media are attractive, accurate, readable, and understandable, they also represent one of the highest deterrents to thinking in the classroom. The media are often used to present exposition so "perfect" as to inhibit all real thinking (or feeling) activity. A number of studies comparing new instructional media with conventional methods of instruction reflect to a large extent the adequacy of instructional technology in an otherwise unchanged and nonfacilitating environment.

11. Media could play an important role in creating a certain classroom ethos (see section on "Media and Classroom Ethos"). The reason behind this assumption could be that certain media are considered to be oppressive whereas certain others are considered to be congenial in that the manipulation of media and control are in the hands of learners. The media falling in the first category dominate the learner and do not allow the learner to participate in the process of communication, as for example, radio and television. The media falling in the latter category are those which work under the control of the learner and could be manipulated by the learner as, for example, tape-slide sequences, radiovision, multimedia packages, and self-instructional materials. Furthermore, media employing human interaction (such as tape-slide, radiovision) are not dependent on the presence of a professionally certified "teacher". Human interaction is often used in conjunction with other modes to support their activity. Students may and will learn from parents, classroom "helpers" and other supposedly unqualified people in the community. But mostly, students will and do tend to learn from one another. Experienced teachers recognize that their students often have ways of making each other understood even when more "professional" approaches have failed. Such group activity (non-directed) can be a powerful means of bringing together the cognitive and the affective involvement of students. Unfortunately, children have rarely been considered seriously as teachers and are perhaps one of education's most underutilized learning resources. Yet their liberation from such prejudice is the ultimate purpose of all education. The education literature is rich on the liberation of education, of the teacher, and even of the traditions of the system, yet the most important mission -- <u>that of the liberation of the learner</u> -- is often neglected. That, to my mind, is the purpose of bringing appropriate technology to the classroom -- the learner's freedom.

V. TECHNOLOGIES OF INSTRUCTION

12. In this paper, technology refers to educational technology. It is not just machines and equipment. Machines and equipment (e.g., computers and projectors) are merely tools, they are not the technology itself. Similarly, software (e.g., programs and films) is also not technology. Rather, technology is a complex, integrated organization of men and machines, of ideas, procedures, and of management. Technology can technically be defined as the systematic application of scientific or other organized knowledge to learning tasks. Its most important consequence is in forcing the division and subdivision of any learning task into its component parts leading to finer analysis followed by optimal synthesis for effective implementation. In this sense, technology is a process, rather than an object. As such, it is more closely related to effectiveness than to efficiency, with people rather than with things. The technology which is appropriate is that which conforms and responds to the perception of the learner. The most important element in the learning process is the beneficiary, the student or learner himself. In this sense, therefore, educational technology is as wide as education itself: it is concerned with the design and evaluation of curricula and learning experiences and with the problem of implementing and renovating them. Educational technology has no other purpose than to free teachers so that they can teach more and better in their own terms and to assist students to learn more and better with a greater sense of personal control over the processes they choose. It contributes to the efficiency of instruction.

13. In a larger context, technology is a state of mind, a lifestyle and not alone hardware, software, or modernization processes. In this sense therefore the technology that works best is one that is appropriate - and in the classroom that really means the technology that liberates the learner. Sharma (1985) concluded that we are at the stage when we can make a very safe, indisputable statement that educational technology does not replace the teacher, rather it helps the teacher to implement his role more effectively. Educational technology could be used to enrich the classroom environment. It has been established through many researches that radio, educational television, use of tape-slide, etc., have greatly improved the methodology and techniques of teaching in the classroom and have been found to be very effective media of education. The following section presents a review of selected studies on radio, tape-slide and radiovision.

VI. REVIEW OF RELEVANT RESEARCH STUDIES

14. If we examine the history of any innovation in the area of teaching, we notice that researches have been conducted comparing the effectiveness of innovative methods with conventional teaching. This happened with educational radio, ETV, tape-slide based instruction, radiovision, peer tutoring and others. The following section presents a broad review of studies made of radio, tape-slide, peer-tutoring and radiovision as instructional media.

A. Studies on Radio

15. Among the various technologies of instruction now being used around the world, ranging from programmed instruction booklets to color television and computers, radio readily emerges as one of the most economical. Radio is a medium or a means of conveying certain kinds of information. It can be a powerful tool but its effectiveness depends not only on its intrinsic qualities but more importantly on how it is used and for what purpose. Development Communication Report (1978) asserted that radio can be used to help formal education systems to meet their goals in four ways. It can help to improve the quality and relevance of education, keep educational costs down and broaden access to education. These four alternative strategies for using radio in formal education must be assessed in terms of users' needs. The first is using radio to enrich learning, i.e., to provide occasional lessons or experiences that most classroom teachers are unable to provide. The second, direct instruction, involves using radio to carry most of the instructional burden in one or more subjects. The third, extending in-school education, is using radio in a monitor-assisted classroom for most subjects that lack qualified teachers, such as geography. The fourth, distance learning, involves the use of radio with some combination of textbooks, correspondence and occasional personal interactions.

16. The potential for using radio in direct instruction in one or more subjects holds out a strong promise and an equally strong challenge to the educator. Let me cite some examples. The Nicaraguan Radio Mathematics project demonstrated how much impact a carefully designed radio curriculum can have on student achievement. In Kenya, radio was combined with correspondence to upgrade the performance of teachers. In a recent survey of experimental and empirical studies of the effectiveness of teaching by radio, Jamison, Suppes and Wells (1973) found some situations in which radio carried the major burden of instruction. Saulat (1977) stated that All India Radio was making a substantial effort towards educational broadcasting of a formal nature. Educational radio has so far functioned as a supporting or supplementing medium to the educational effort, but even this role has not been fully exploited. Aman (1976) reported that during one term, the intermediate-level teachers on an average utilized between 30 and 40 radio programs and some 5 TV programs. A comparison between different types of population districts showed that programs utilization was lowest in large cities and school radio programs were listened to almost solely on tape recorders. Frey (1976) concluded that through radio as a medium, it was possible not merely to motivate pupils and make topics more concrete, but we could also start new processes in the classroom, which could develop the pupil individually and socially.

17. Spain began a project called "radio-primaria" in 1970. This project brings classes by radio to fourth, fifth and sixth graders to make up for the lack of teachers in these grades in rural areas. Achievement tests were given to the sixth grade students and

questionnaires to teachers in all six primary grades. Only some of the students and some of the teachers were using the "radio-primaria" system, so two groups could be compared. Children taught with the radio, it turned out, were receiving an education comparable to that of the children in the conventional system -- that is what the achievement scores indicated. The findings of the project show that the few schools that have been expanded by "radio-primaria" show numerical increases in enrollment that "radio-primaria" made possible.

18. MacMohan (1976), on studying the radio-series, reported that pupils and teachers reacted enthusiastically to the radio programs. Because of these programs, the whole atmosphere of the school was changed. Among the various programs, the music series was the most popular. The story-telling series was also popular. In some areas, due to the differences of dialects, there arose problems of comprehension. The environmental studies series was largely dependent on the teacher since he was concerned with developing in the children an awareness of their environment, and the themes and concepts introduced needed to be developed and expanded. It was concluded that for primary schools, the radio-series were an effective and valuable resource.

19. Mullins, et al (1976) undertook a study to describe an evaluation of the structural courses presented by SUV radio station between June 1972 and December 1974. All courses were noncredit and based on both general interest and vocationally oriented topics. These radio programs were supplemented by an extensive notes kit and sometimes by live tutorials. A multiple-choice questionnaire was distributed to all enrolled students. The findings of the study revealed that: (i) the majority of subscribers were relatively young (30 to 40 years); (ii) the respondents were evenly divided into two groups: those doing the course for general interest and those doing it for vocational reasons; (iii) the educational radio did not seem to be reaching sections of the community excluded by time or opportunity from the more traditional adult education courses; (iv) it appeared that dropout rates were very low and students participated actively by taking notes and reading reference materials; and (v) two thirds of the respondents expressed their satisfaction in terms of rate and level of presentation, degree of interest, and the length of individual unit of the courses.

20. Khan (1977) studied the use of radio for rural education in developing countries. For this purpose, he tried to determine what role radio can play in the educational development of rural people in developing countries and how this medium can be used effectively and economically to overcome the problems faced by the governments of developing countries in their rural development efforts. Radio was found to have certain advantages over TV especially in its use in these countries, particularly in terms of time, cost-effectiveness and localness. Five strategies used in educational radio projects have been analyzed. Based on the analysis, it was concluded that most of the efforts in using radio for rural development have been largely fragmented. There were a few projects that involved a significant

number of people, but the projects reached only a minute fraction of their potential audience. Lack of careful planning and administration was also found in most of the cases reviewed.

21. Searle (1977) carried out an investigation to develop and test a mathematics curriculum dependent upon radio presentations and the use of teacher-directed activities as a supplement to the radio lessons. The content of the lessons was broken into lesson segments, from which individual lessons were developed and translated into 20-minute radio scripts, supplemented by student worksheets and teachers' guides. It was found that the greater the demand for active student response in the radio lessons, the more effective these lessons were. Consequently, the format of the lessons gradually changed to a fast-paced active-response style that demanded oral, physical and written responses from the students. The skills taught were reinforced by mixed drills, so that the topics introduced reappeared subsequently in frequent, short-practice lessons throughout the schoolyear. In general, the experimental group performed well.

22. On the basis of the review of studies in the preceding paragraphs, one can reasonably say that radio was found to be an effective medium of instruction as it encouraged active responses on the part of children. Lessons on mathematics have been found to involve children more intensely than stories. "Radio Primaria Project" helped in increasing enrollment and in further strengthening the processes of rural education. It was noticed that besides injecting motivation among pupils, radio could also be used to initiate new processes in the classroom to develop the pupil individually and socially. Interactive radio instruction system is a further development in this field. It is helping to meet needs of providing high-quality education at a low cost. This system is either being adopted or introduced into national curricula and its activities are being institutionalized in the education system of several countries including Honduras, Bolivia, the Dominican Republic, Papua New Guinea, Lesotha and Nepal. Aside from its cost-effective utility as a medium to reach thousands of people at least expense, radio also represents a powerful tool for use by the teacher in-class. Many countries already have educational programs aired on radio which reach remote rural-based classes according to fixed broadcast hours keyed to classroom lessons and assignments. Such broadcasts can supplement teachers' efforts and make available to hundreds of classrooms the nation's best and most gifted teachers by taping their lectures and airing these lectures. In addition, radio represents a powerful adaptation called radiovision, which utilizes cassette tape lectures, and slides in proper combination, to bring audio-video advantages to the classroom.

B. Studies on Tape-Slide

23. Classroom instruction is the pivot of our educational system. It takes place in a group situation. Tape-slide materials are most suited to such group instruction. We can use a single slide projector

and a tape player which can provide learning experiences to a large number of students at one time. In this way, per capita cost in education gets reduced. Synchronized slide-tape presentations have become very popular, particularly in the field of education. Tape-slide (TS) learning materials are those in which the subject matter is presented through two channels, viz., the audio and the visual. The student looks at the visuals which are presented on the screen through slide projectors and listens to the explanations which are given through the audio-cassette player. There are many advantages of these materials. They stimulate the teacher's functions in a classroom. Teacher's talk is taken over by the tape and his "chalk and board" are replaced by the slides. They expose accurate and standardized sequence of messages. They are apt to contain more clarity and realistic details to sustain student interest, curiosity and concentration. The voice on the tapes emanate from a professional speaker. All types of sound -- animal, human, mechanical -- can be fed into tapes to produce realistic effects. They are also flexible in use. They can be used in large classes of about 300 students. TS materials are even better than the audio-motion visuals like films, TV and video-tapes in many situations. They are relatively inexpensive. Their equipment, viz., tape recorders and slide projectors, are easy to handle for the teacher as well as learner. Their software, such as slides and tapes, are easily developed. They can be edited and modified in a shorter time with less cost. However, TS materials also have their limitations. They cannot display motion which is possible through films and TV.

24. Maccini (1969) carried out an investigation to develop an AVT program consisting of tape-slide and other materials in an Introductory Geology Course. He set up 24 study carrels in an AVT laboratory, each equipped with a film loop projector with head set, a slide projector, a desk lamp and appropriate teaching- learning materials. He divided 135 students into three groups of 45 each. Post-test scores were found to be significantly higher than pre-test scores in all the cases.

25. Smith (1979) examined certain instructional materials produced to utilize an audio-visual mode of presentation in a structured, concrete and applied manner would which affect the students' conceptualization of basic mathematics as they relate to measurement in carpentry. An analysis of co-variance was used to test the difference in treatment and control groups' mean scores on the Fractions and Carpentry Post-tests. A significant difference was found between the treatment and control groups' mean score on the carpentry post-test. It was concluded that this mode of presentation was feasible and was therefore recommended for other technical programs.

26. Jenkins (1969) conducted an experiment on four tape-slide presentations on graphic arts, and compared their effectiveness with traditional teaching. He conducted the study on two groups of junior high school students for evaluating the terminology and procedural detail tests and procedure tests. He found that the experimental group's achievement on the learning of terminology and procedural detail

tests was significantly superior to that of control group at 0.01 level. But there was no significant difference between the two groups on the procedure test.

27. Jamison and Merchant (1971) compared the effectiveness of a tape-slide lesson on new decimal coinage with an illustrated booklet on 33 female subjects of mean age 33 years. The tape-slide lesson consisted of 33 slides and associated tape with a running time of 20 minutes. A comparison was made between the groups for percentage gain between pre- and post-test and it was found that there were no significant differences between the groups. Hill (1973) evaluated the effect of the use of tape-slide units in teaching general chemistry vis-a-vis the conventional method of teaching. The study was conducted on 176 students divided into four groups. Analysis of pre-test and post-test scores of all the four groups indicated a significant improvement at 0.05 level of significance. However, the experimental sections were not significantly different from each other.

28. Jones (1975) investigated the comparative effectiveness of video-cassette and slide-tape presentations for self-instruction of paraprofessionals. The post-test performance of the slide-tape group was significantly better than that of the video-cassette group. One-way analysis of variance of the total study population showed that both self-instructional presentations resulted in highly significant improvements in post-test and retention-test performance when compared to pre-test performance. Davis (1975) designed a test to examine the relative efficiency of a slide and sound presentation in a unit on the Radio-Telephone Third Class License with Broadcast Endorsement. The controlled group was taught through the traditional method of lecture and demonstration, whereas the experimental group was taught the same unit by means of slide and sound presentation. Both the experimental group and controlled group made a statistically significant gain in the amount of knowledge acquired. The application of the Maun-Whitney test demonstrated that a greater amount of knowledge was acquired by the students of the experimental group. It was concluded that the combined slide and sound presentation method was more effective than the traditional method of teaching.

29. Richason (1967) compared the examination grade distribution of his students taught through the tape-slide method of interpretation with the earlier students who had taken the course under the conventional method of instruction. He reported that the average grade of his students was 16 per cent higher than the average of the previous ten years. Brewer (1971) administered pre- and post-tests while teaching musical textures through his tape-slide presentations. He found that his students made significant gains from the pre-test to post-test at .05 level.

30. Butts and Prickett (1969) compared the relative effectiveness of tape-slide materials in audio-tutorial laboratories and conventional teaching as done in traditional laboratories based on student

achievement in accounting principles. The tape-slide material group (experimental) received traditional instruction and materials consisting of tape-slide materials and assigned audio-tutorial laboratory experiences. The control group received traditional instruction as given in the laboratory without the use of tape-slide materials; the experimental group achieved as well as the control group in the accounting achievement test. According to these researches, the advantage of the tape-slide approach was that students had the opportunity to select the time for laboratory work. This approach also had the possibility of handling larger enrollments in accounting principles courses without having to increase staff size.

31. Young (1969) compared the effects of a tape-slide presentation and a conventional type-printed brochure providing information concerning the preparation and career of an industrial arts teacher. The study was conducted on 126 eleventh grade boys in six public high schools. It was found that there was no significant difference between the effects of the two methods regarding student knowledge or attitude. But both the methods were effective because students had more significant favorable attitudes and increase in knowledge. High-ability students showed equal or greater gains in attitudes than low-ability groups.

32. McVey (1970) conducted a study to compare the effectiveness of tape-slide materials in the teaching of four programs in vocational agriculture with conventional teaching. This included the study of animal health, commercial fertilizers, small gasoline engines and farm credit. The experiment lasted 14 days. The tape-slide presentations lasted a maximum of 20 minutes utilizing 59 slides or less. The tape-slide materials for the teaching of animal health, commercial fertilizers and small gasoline engines were found to be as effective as conventional teaching.

33. Onah (1971) conducted a comparative study in which 108 students learnt principles of accounting in Michigan Community College. The students were randomly assigned to two groups, i.e., experimental and control. The experimental group received individual instruction in carrels in the AVT laboratory using tape and slides. Additional assistance was available from a tutor at the student's convenience. The control group was taught by the conventional method. The students were administered an aptitude test, three periodic tests, final examinations and an opinionaire. The major findings were that the tape-slide method was as effective as the conventional method. The low-aptitude students performed better with the tape-slide system when it allowed them to spread their time and work at their own pace. Students in general liked the AVT system as a method of instruction.

34. Elliott (1978) designed and conducted the study to determine the effectiveness of audio-tutorial mini-courses in increasing achievement in the biological sciences at the college freshman level. Seventy-five students in an experimental group and 79 students in the

control group attended the courses. The result indicated that 96.9 per cent of the students achieved 70 per cent of the stated behavioral objectives. The study concluded that there was no significant difference between the post-test means of audio-tutorial group (experimental) and the library research group (control) when the data were treated by analysis of co-variances.

35. If one looks into the studies on the efficacy of tape-slide materials reviewed in this section, one will find that in most of the cases the efficacy of tape-slide materials has been studied by comparing them with traditional classroom instructional methods. Almost all the studies revealed that tape-slide materials have been found effective when compared to conventional methods of teaching and conventional printed material. Audio-visual systems of instruction were found to be optimally effective in almost all cases. However, results of different comparative studies revealed that, in most cases, studies ended with no significant differences. When the tape-slide presentation was supplemented with group discussions or notes, it was found to be more effective. Moreover, these studies have demonstrated that the tape-slide method of instruction could be a viable instructional method. The tape-slide approach could be extended through radiovision and at the same time it could be helpful in optimizing the use of radio for instructional purposes.

C. Media and Classroom Ethos

36. The educational ethos of a classroom describes the value-oriented perceptions of the students to explicate the "educativeness of the classroom" in terms of: (i) authenticity (A) (Pupils' involvement, i.e., pupils' meaningfulness, understanding, pleasant experiences, lively, exciting and dramatic situations in learning activities); (ii) legitimacy (L) (Pupils' satisfaction); and (iii) productivity (P) (Pupils' goal attainment). Media could play an important role in creating a certain classroom ethos (see paragraph 11).

37. Singh (1986) conducted a study on randomly selected 240 students of tenth standard of Boys' Secondary Schools of Sardar Shahr (Rajasthan) to investigate the relationships between classroom ethos and media of instruction. Four pairs of groups each having 30 students were formed by matching their age, science attitude scores and intelligence scores. The groups were also matched on mean achievement scores on the pre-criterion test. Out of eight groups, four groups were selected for replication of the experiment. Each group was allotted to a particular treatment randomly selected for the experiment.

38. Thelen's ALP-classroom Ethos Instrument (1972), was adapted to measure classroom ethos. Programmed Learning Materials on the theme, "Reproduction" for the tenth grade were prepared in Hindi in three formats: (i) linear book format; (ii) tape-slide format; and (iii) audio-tape format. The different instructional media (in terms of formats) were the independent variables (treatments) and the students'

achievement on the post-test and ALP scores of classroom ethos were the dependent variables. The pre-test, post-test design was used to test the null hypotheses. Analysis of variance (F-test) with a derived technique of least significance difference (LSD) was used to test the significance of difference among the mean achievement scores of four groups and their replicates. The following are the findings reported by the researcher.

39. All the four groups and their replicates, except the PLM Book format group, gave top priority to the productivity aspect of the ethos for 'actual' post and "ideal" classroom situations. In addition:

(i) Those groups getting instruction through the tape-slide program, PLM in book format and teacher in traditional way, perceived "actual" post-ALP ethos nearer to their perceptions of the "ideal" classroom. Therefore, it was concluded that these media have been capable of creating their perceived ideal classroom situations.

(ii) The audio-tape as an instructional medium was not found effective in creating an "ideal" classroom ethos with special reference to the legitimacy and authenticity aspects.

40. No significant difference was found between the gain scores of the traditional and tape-slide treatments as well as between the gain scores obtained by the PLM-book format and audio-tape treatment groups. However, both the traditional and tape-slide treatments were found to be significantly better than the PLM-book or the audio-tape treatment.

41. It was found that the groups getting certain instructional treatment and perceiving their "actual" classroom to be nearer their "ideal" classroom in terms of ALP ethos (in the present study tape-slide program and teacher in traditional way) also achieved high gain scores. Therefore, it may be concluded that the use of any media treatment in the teaching-learning process, if capable of creating ideal classroom situations, would also be helpful in achieving high performance scores. These results demonstrate that the media of instruction not only influence the performance and motivation on the part of students but also affect the classroom ethos. Therefore, there will always be the need for selection of appropriate media and modes of instruction to create the congenial learning classroom climate in terms of group ethos.

D. Peer-Tutoring and Instructional Media

42. Peer-tutoring and self-instructional module are two main strategies for individualization of instruction which have been found to be more effective and less time-consuming than the conventional methods, according to a number of studies (Anderson, 1980; McCarthy, 1976; Dunson, 1977; Robinson, 1979; Stevens, 1979; Crockett, 1980; Jones, 1979). These instructional strategies may have special relevance for developing countries where the number of children needing education is

enormous and the material and human resources available for this purpose are far from sufficient. Moreover, these strategies do not require sophisticated gadgets and high technical knowhow for development and implementation and they are cost-effective. Furthermore, one of the more innovative professional developments in education is the discovery that children can participate in the delivery of educational services for special classroom instruction. Children, traditionally viewed as recipient of these services, now are seen as potential sources of help and assistance. In an increasing number of programs, specially in peer-tutoring, children function as tutors for same-age or younger pupils (Lippitt & Lohman, 1965; Shapiro & Hopkins, 1967; Frager & Stern, 1970).

43. A peer-tutoring system is not a set of instructional materials or texts; it is not competitive with textbooks or instructional media; it is a management system for using existing instructional materials and texts. It is a peer-mediated learning system governed by two principles: (i) learners exercise full responsibility for their own instructional progress; and (ii) learners provide pacing and coaching assistance to others.

44. Thiagarajan (1973), while summarizing the benefits of peer-tutoring for the tutee and the tutor, concluded that the tutee receives undivided, individualized attention from his tutor, who speaks the same language as himself, and comes up with examples and explanations which are within his grasp. He feels that he is understood by somebody who has recently had the same problems as himself and has surmounted the same difficulties; he is not on the defensive, since he does not have to confront adult authority; finally, he feels free to ask any questions he likes, fearlessly. A carefully-managed conscious exploitation of peer-tutoring principle should thus produce a great multiplicity of benefits, such as positive attitudes towards learning, improved use of the tools of learning, a variety of learning skills and greater self-esteem.

45. Rathore (1982) likewise conducted a study on peer tutoring. The major objective of this study was to compare the relative effectiveness of peer tutoring, self-instructional module and traditional method of instruction. The study was conducted on the students of ninth grade of the Central School, Surat. Sixty students were randomly selected for the experiment and were distributed in three matched-groups on the basis of age and intelligence. Each group (N = 20) was randomly assigned to a particular treatment.

46. The unit "Protozoa" from the biology course prescribed for ninth grade was selected as content and a self-instructional module in book format was developed by the investigator for the Experimental Group. Pretest and post-test design was used for the experiment. The criterion test, developed by the investigator, was administered to the control and experimental groups before and after the experiment to generate pretest and post-test scores.

47. The data obtained from the experiment were subjected to one-way analysis of variance to test the null hypothesis. The obtained "F" value of 4.3199 was found to be significant at .05 level. The null hypothesis was rejected and it was inferred that the differences in achievement among the three groups receiving instruction through different methods of instruction were indicative of real differences. To follow up the "F" results in order to make positive comparisons, Sheffe's test was used. With three means, three comparisons were possible. Two out of the three comparisons were found to be significant. One was found to be significant at .01 level, whereas the other was significant at .05 level. It was observed that the performance of the learners of the peer-tutoring group was significantly higher as compared to the learners receiving instruction through self-instructional module or conventional method of teaching. The mean difference between the peer-tutoring group and the self-instructional module group was found to be significant at .01 level, whereas the mean difference between peer-tutoring group and conventional method group was found to be significant at .05 level. Hence the mean difference was highest in case of the learners receiving instruction through peer-tutoring. The learners who received instruction through self-instructional module did not obtain significantly higher mean gain scores than the learners who received instruction through the conventional method. It can be inferred from these results that peer-tutoring produced significantly better results than either self-instructional module or the conventional method. The peer-tutoring strategy has been found to be superior to the self-instructional module and traditional method of instruction. This finding is in conformity with the results obtained in the earlier studies by Dunson (1977), Robinson (1979), and Jones (1979), but it contradicts the findings of Rosenbloom (1977) and Wagner (1980), where lower gains for peer-tutoring were reported. It also contradicts the findings reported by Lo Guidice (1977) and Zaher (1978) which revealed that self-instructional module was as effective as peer-tutoring. Furthermore, the findings of Rathore's study have demonstrated that a self-instructional module as a method of instruction could be at least as effective as the conventional method.

48. Rathore (1985) conducted a comparative study of two Instructional Methods, Modules and Peer Tutoring for Teaching Biology. The objectives of the study were to: (i) obtain data about the efficacy of self-instructional module as an instructional strategy; (ii) obtain data about the efficacy of peer tutoring as an alternative instructional strategy; and (iii) compare the relative effectiveness of self-instructional module, peer tutoring and traditional methcd of instruction.

49. Experiment was conducted in two phases. In the pilot experiment, 78 students were divided into three matched groups on the basis of age, intelligence and achievement in English. The final experiment was conducted on 106 students of IX standard of Kendariya Vilalaya, Ahmedabad. The students were divided into three matched groups and one control and two experimental groups (self-instructional

module and peer tutoring groups) were formed. Self-instructional module, workbook, criterion test, attitude opinionaire, teachers' questionnaire, and intelligence test were used to collect the data. An appropriate peer tutoring model was also designed by the investigator for one of the experimental groups. In both the phases of experiment, pre-test/post-test design was used. For developing self-instructional module, the unit "Morphology of Flowering Plants" from biology course prescribed for Class IX was selected.

50. Findings of the study indicated that (i) self-instructional module and peer tutoring were found to be viable methods of instruction; (ii) peer tutoring was found more effective method of instruction than either self-instructional module or traditional method; (iii) self-instructional module was found more effective method of instruction than the traditional method; (iv) attitude of the learners towards the self-instructional module and peer tutoring were positive; and (v) teachers considered both self-instructional module and peer tutoring appropriate for the learners, capable of sustaining the interest, effective for all topics as well as for studies at home.

51. The findings of the study demonstrated that self-instructional module could also be used as an alternative method of instruction in the formal classroom situations and it could be as effective as the traditional method of teaching. In the formal classroom situations, peer tutoring may also be used as a method of instruction in the absence of the teacher as well as method of instruction for remedial teaching. Cross-age peer tutoring by senior students may help in overcoming the problem of shortage of teachers in the schools. As the strategies of self-instructional modules and peer tutoring do not require sophisticated resources, both could be used as low cost strategies for solving the problems of education in the formal as well as nonformal education programs in developing countries.

52. The studies reviewed under section VI have covered media and method studies. Media included both the mass media like radio and small media such as tape-slide, and audio-tapes. The majority of these studies have been experimental and comparative in nature. When looked at from the methods angle, individualized methods, distance education and peer-tutoring were most common. In one of the studies, an attempt was made to study media with reference to classroom ethos. Synthesis of these findings is difficult because these studies involved different variables and objectives. These studies have been reviewed to provide appropriate background to the discussion of radiovision-related research.

VII. EXPLORING A NEW INSTRUCTIONAL SYSTEM: RADIOVISION

53. The past two decades could be described as an era of innovations in education in addition to being a revolution in communication. Investigations have proved that the use of projectors to illustrate history, geography and general science lessons, use of the

tape recorder for improving oral expression, narrating stories either individually or in groups, the use of films for the teaching of sciences, technology and arts subjects, the use of the radio in teaching music, presenting linguistic models and pronunciation drills, have all been found very effective. It has also been found that these activities, at the micro-level of the class, have helped in classifying concepts, stimulating group and individual activities, changing attitudes, imposing a new structure or organization on certain subjects and encouraging originality and creativeness. This can partially be attributed to the increased influence of educational technology in class-room instruction. Rapid expansion of knowledge, science and technology, and an unprecedented increase in the number of students in the class and outside the formal system, have warranted the use of mass-media systems like radio and television as well as emphasized the use of self-instructional materials. Thus two problems -- first, optimal utilization of mass media potential, and second, extension of message on radio and TV over time -- had to be tackled simultaneously.

54. Mass media (particularly radio) are recognized as an important alternative for meeting the crisis of declining quality of instruction in developing countries. While most nations have greatly expanded their enrollment during the past two decades, they are finding it increasingly difficult to meet the rising costs of education, let alone improve the quality of instruction. Besides, financial constraints every country is facing today also suggest a search for an effective and economical instructional system which can be useful both in and outside the classroom. This in turn warrants the use of educational technology. Sharma (1985) emphasized the importance of educational technology by saying that it helps the classroom teacher in executing his role more effectively.

55. In the classroom context, TV is considered to be one of the best instructional media. Radio is another instructional medium, which is economical when compared to TV. Now the question arises: "In the age of TV, has pedagogical radio a future?" Radio provides stimuli in auditory form whereas TV presents stimuli in both auditory and visual forms. Radio, as a medium of communication, is not considered suitable for populations having "cold" culture as is the case in developing countries because radio is considered to be a "hot" medium which in turn is considered to be an appropriate communication medium for the populations of developed countries. Then another question arises: "Are we in a position to provide TV to all the habitations of developing countries and especially in rural areas?" First, in terms of cost, TV is relatively more expensive than radio and the ratio comes to approximately 10:1. Hence in developing countries, it is not possible to provide TV facilities to all the distant corners of such countries, particularly at this moment. Second, it is rather difficult to produce TV programs which require enormous technical know-how. Statistics from European countries confirm that it is still a very complicated affair for schools to use TV programs as against easy handling of radio broadcasts. But, we cannot be satisfied with the sound only and at the same time cannot afford to lose benefits of visual stimuli.

56. Radiovision could provide an answer to some of these problems. It is an integrated whole of both vision and sound. Radiovision is an instructional system in which the subject matter is presented through two channels: the audio and the visual. Radiovision is a system in which students look at the visuals which are presented on the screen through slide projectors, filmstrips, charts, models, etc., and listen to the explanations which are given through the cassette player. In addition to audio and visual components, radiovision includes teacher's notes and student's notes as useful adjuncts. These supporting materials make comprehension on the part of the student much more easy and effective. Thus, radiovision provides both sound and pictures as TV. In addition, it has been developed as a source of audio-visual material for language teaching; as a source of inspiration and strong visual impact; and as a medium in its own right capable of enriching the individual's experience. Second, tape-recording in radiovision encourages the more effective use of school radio. The teacher can hear the tape before its use while the pupils can use the programs when they are at that stage where they can benefit the most. Pupils as well as teachers can hear the tapes at times convenient to themselves. Radiovision requires the schools to be equipped with film-strip projector, radio, film strips, slides and a tape recorder to record the programs.

57. Besides this, in the case of radiovision, pace of audio and visual components could easily be harmonized with the pace of comprehension on the part of students. Hence, radiovision could meet pedagogical needs of slow, average and bright learners equally effectively whereas TV programs proceed irrespective of the pace of the learner, and the comparative rapid succession of pictures and words may render comprehension more difficult. It is not an oppressive medium (see paragraph 11) because it can be manipulated by the student who controls it. Therefore, it increases opportunities of participation by the learner in the teaching-learning process. The BBC claims to have started with radiovision systematically in 1964. It seems to have been advancing in the last few years. The Swedish have also produced more than 100 radiovision series in the last decade. The Denmark Radio has produced about 95 new radiovision series for schools during the period 1977 to 1985. Radiovision offers itself as a cheaper substitute to educational TV (sometimes even cheaper than tape-slide system of instruction). Sharma (1976) concluded that "radiovision" could possibly prove to be an effective medium of instruction both in formal and nonformal situations.

58. Radiovision has the following advantage points against TV: (i) it is economical in terms of money and effort; (ii) it is most favorable to school viewers because they have the requisite equipment and can use it independently of radio hours; (iii) it is rather easily manipulated because students can go back and forth or remain where they are, take an extra look and discuss the individual pictures as long as they like; whereas in the case of TV a rapid succession of pictures and words make slow learners nervous; (iv) it produces better pictures than

TV; it is more correct, has more color and finer details; (v) it may afford better possibilities for integration of sound and picture, which is so difficult to create in TV, except that it cannot display motion; and (vi) radiovision's great advantage is that the radio part can be taped at the school and the pictures can be hired (which can be centrally produced) or bought.

59. Besides these advantages, the number of original broadcasts as well as repeats of school radio programs can be dramatically cut as more and more schools start using radiovision. It increases the potential of radio as an instructional medium and at the same time makes it possible to reach all habitations of the country which at the moment are not electrified and not possible to reach with TV. With the help of radiovision, it is possible to limit new productions of TV educational broadcasts. Furthermore, the form of production of radiovision is so simple and easy that there will be time and opportunity to concentrate on how words and pictures can explain and strengthen each other and become equally worthy forms of expression in the finished work, which is difficult in the case of TV. Besides being economical, the advantages of using radiovision are such that it pays off, both in terms of quality of instruction and in terms of making use of volunteer as well as senior students and unqualified classroom teachers. Radiovision could, possibly, prove to be an effective medium of instruction in both formal and nonformal situations. Rather than put more capital investments in sophisticated hardware, most research and development funds could perhaps be incorporated in the concept of radiovision. A handy portable kit, which can be carried by the teacher to any classroom in the rural areas, should be designed further to what is already available so that a battery-operated cassette player and slide projector can be made available to the teacher. The use of audio-visual media has proven effective beyond any doubt -- the need now is to package this into portable form and radiovision presents that opportunity.

60. Sharma and Tripathi (1979a) conducted an experimental study on radiovision. The findings of the study revealed that the teaching of geography could be made more effective through radiovision than through traditional methods of teaching. Sharma and Tripathi (1979) also reported that radiovision has been found to be significantly better when compared to traditional classroom instruction methods for the teaching of mathematics. In another study, Sharma and Tripathi (1979c) concluded that the teaching of history could also be made more effective with the help of radiovision than by traditional classroom teaching. They found that the radiovision program was uniquely capable of holding the children's interest for its entire length with few exceptions and the radiovision program demonstrated many of the points intended by the objectives and would serve as an excellent and effective stimulus. Furthermore, Sharma and Tripathi (1980a) suggested that radiovision could be fruitfully used for the teaching of biology. Also biology teaching becomes more interesting when taught through radiovision. While testing the effectiveness of radiovision, Sharma and Tripathi

(1980b) reported that the system could be used effectively to handle the problem of motivation in the classroom and making the classroom instruction more lively. Sharma and Tripathi (1980c) also conducted a study on efficacy of radiovision and concluded that radiovision was found to be an effective instructional system in the formal classroom situation. Further, they stressed the need for replication of studies regarding efficacy of radiovision.

61. Tripathi (1979) studied efficacy of radiovision as an instructional medium. He compared radiovision as a method of instruction with the traditional method in terms of performance of students on criterion tests. The efficacy of radiovision was tested in terms of comprehension, attention, and appeal on the part of the students. Two sections of Class X of Central School, Surat, each consisting of 20 students, were adopted for the experiment. One of these sections was treated as a control group and the other as an experimental group. Treatment was assigned on a random basis. The experimental and control groups were matched on IQ scores. The research tools developed by the investigator for evaluation of the radiovision included: (i) criterion test, (ii) end-of-program structured interview, iii) teachers' questionnaire, (iv) attention profiles, (v) observer's class profile, and (vi) expert judgements. Radiovision lessons on "Inheritance", "Microbes and How They Grow", "Measuring Time", and "Height and Distance" were used for the experiment. The first three were prepared by BBC and adopted for the study, whereas the fourth radiovision program was developed by the investigator.

62. The results of the study revealed that the radiovision method of instruction was significantly better than traditional classroom instruction in terms of performance of students on criterion tests in the case of two radiovision programs: (i) "Microbes and How They Grow", and (ii) "Height and Distance". In the case of the lesson on "Inheritance", no significant difference was observed.

63. Administration of the post-test was followed by interviews of a few randomly selected students. Almost all students of the experimental groups who were interviewed suggested that the radiovision program on "Inheritance" as a whole was interesting. In the case of the radiovision "Microbes and How They Grow", the results of the interviews as well as the criterion test indicated that a detailed comprehension of the teaching points involved in the lesson was attained by a great majority of students. Similar results were also obtained in case of the radiovision program "Measuring Time". Attention measures regarding "Height and Distance" radiovision lessons revealed that the program was uniquely capable of holding children's interest for the whole of its duration except at the beginning. Some students were also seen taking notes. The program was rated very high on the attention measure. The experts opined that the programs "Inheritance", "Microbes and How They Grow", "Measuring Time" and "Height and Distance" were interesting and they fulfilled the instructional objectives to a great extent.

64. It could be concluded that out of the four radiovision programs tested, three produced significantly better results as compared to the traditional classroom instructional method. Thus one could infer that radiovision has proven to be a better instructional system in the formal classroom setting. The data also revealed that the system could attract and sustain attention of students throughout the presentations. This system can help in dealing with motivational problems in the classroom as well as in minimizing dropout rates to a great extent. The teachers felt that the teaching of science could be made meaningful and the involvement of students in the teaching-learning process could be significantly increased if the radiovision is followed by group discussion with the help of the subject teacher or group leader.

65. These findings should not lead one to conclude that the teacher could be replaced by radiovision. Instead it would be safer to conclude that radiovision can help the teacher in making classroom instruction much more interesting or in fruitful utilization of the time of students when the teacher is absent. Instruction through radiovision could be made more meaningful if the same is followed by group discussion such as in following the peer-tutoring strategy.

66. In case of radiovision, the radio broadcast is synchronized with visual frames in a systematic way to facilitate comprehension on the part of the learners. It helps in converting the radio (hot medium) into a cold medium and converts the message into more concrete form. Radiovision consists of sound tape, filmstrips or slides and teachers' notes. It may prove to be positively more effective if work books are also provided to students while radiovision is on. The focus of these researches has been what is immediately applicable to rural-based populations, which comprise 60 per cent of the world's inhabitants. If education is to be useful, it must be useful first and foremost to rural people and villages since they comprise the bulk of a nation's citizenry. It is clear that their poverty and underdevelopment do not allow them access to capital-intensive technology. Rather, the most cost-effective technology should be designed to aid the teacher in classrooms out in the countryside. Radio is one such technology. To this can be added the concept of tape-slides. Then if we supplemented this with peer-tutoring and counselling, involving not only teachers but classmates and young folks and students, then we have the ingredients for the right, enthusiastic, and vigorous classroom ethos for learning.

VIII. MAJOR EXPERIMENTS ON RADIOVISION

67. An analysis of the studies on radiovision reviewed under the preceding paragraphs revealed that in most of the cases, radiovision as a system of instruction was found to be the better method of instruction than the traditional system. The findings also revealed that radiovision presentations attracted and sustained students' attention to a very high degree and was also found to be of high appeal. In view of these findings, three major studies were undertaken in this area, which are described in the following paragraphs.

A. Efficacy of Radiovision as an Instructional System

68. Sharma (1980c) conducted a major project to study "Efficacy of Radiovision as an Instructional System". This study was both developmental and experimental in the formal classroom situation. The experiment was conducted in three languages -- English, Hindi and Gujarati.

69. Pilot Study. The pilot study was conducted in three different languages, viz., Hindi, English and Gujarati. For this purpose the radiovision programs prepared by B.B.C. were translated into Hindi and Gujarati. In the case of English, out of six programs, four were recorded by an Indian, whereas the remaining two were used in their original form. The six radiovision programs were: (i) At the Zoo, (ii) The Tower of London, (iii) Measuring Time, (iv) Changing City-Birmingham, (v) Microbes and How They Grow and (vi) Inheritance. The pre-test and post-test design was used for the study. For each program, two groups, i.e., experimental and control groups, were formed. Each group was composed of 25 students. In all 900 students were involved in this experiment. All experimental and control groups were matched with respect to intelligence, socioeconomic status and age.

70. Final Phase. The final phase of the project was conducted only in the Hindi language. Eight radiovision lessons were developed by the project team. These lessons were: (i) Universe and Sun Family, (ii) Parts of a Flower, (iii) Insects, Our Enemies and Friends, (iv) Reproduction, (v) Atomic Structure, (vi) Refraction in Lens, (vii) Refraction on Plain Surface and (viii) Do Charanka Ke Madhya Rekhey Asamtye.

71. In the final phase, three matched groups were formed, viz., experimental group, control group, follow-up group. A total of 1000 students participated in this experiment. The pre-test/post test design was used for said study.

72. Evaluation of Radiovision. For the evaluation of radiovision, the author identified three areas of concern which were: (i) comprehension, (ii) attention and appeal and (iii) fulfillment of objectives. The measurements used to cover these areas were: (i) end of program students' interview, (ii) teachers' questionnaire, (iii) experts' judgement, (iv) attention measures, (v) observers' (class profile) and (vi) criterion tests. Univariate analysis of variance and "t" techniques were used for analysis of data.

Discussion of Results

73. Pilot Phase. The experimental groups in the programs "Tower of London" and "Microbes and How They Grow" produced significantly better results in Gujarati and English languages as compared to their counterparts, but neither of them produced significantly better results in Hindi. The program, "At the Zoo" produced significantly better

results in Hindi whereas in the Gujarati and English languages, the same did not produce significant results. The program, "Changing City-Birmingham" produced significant results in the English language, but did not demonstrate any significant difference in the Hindi and Gujarati language groups. Radiovision "Inheritance" was found to produce significantly better results in the Hindi and Gujarati language experiments whereas it did not produce significant results in the English language. The program "Measuring Time" produced significantly better results in the Hindi and English languages but did not demonstrate significant differences in the Gujarati language. The analysis of data of the pilot phase therefore revealed that none of the six programs produced significant results in all the three languages.

74. Data regarding "end of the program structured interview", helped to conclude that the majority of the students took part in the interviews with great confidence and arrived at a consensus that they liked the programs. Performance on the criterion test, combined with the results of the structured interview, led the investigators to infer that satisfactory comprehension on the part of the majority of the students was achieved. Teaching objectives were common in all the three languages in each radiovision lesson. In almost all the cases, the majority of the teachers maintained that the instructional objectives of each lesson were important. Achievement regarding these objectives was rated to be highly satisfactory. Teachers rated all the programs as satisfactory from the point of view of content, language and vocabulary. Attention profiles revealed that more than 80% of the students in Hindi and English programs watched the programs very attentively whereas in the Gujarati language, only 50% of the students watched the programs attentively. These findings suggest that radiovision as a system of instruction is capable of attracting the attention of students and maintaining their interest in the program. The data obtained through observers' class profile also supported these results. Experts' judgement was another measure of evaluation used for examining the efficacy of radiovision. Experts expressed their opinion from the points of view of structure of the program, content, quality of sound tape and film strips. In some cases, experts were not satisfied with the quality of the sound tape in terms of voice and speed of commentary. Expert comments were used for modification of radiovision programs. In general, in almost all the 18 cases, experts asserted that the radiovision programs worked as effective stimuli.

75. Final Experiment. The final phase of the project was conducted on students of VIII, IX and X classes of Government Boys and Girls' Secondary Schools of Dusa in Rajasthan. This was done after a period of one year. Eight radiovision programs were developed and tried out. In the case of boys for each experiment, three matched groups were prepared. These groups were matched with respect to intelligence and socioeconomic status. Out of the three groups in each case, one was considered the control group and the other two, experimental groups. Out of the two experimental groups, one was taught through radiovision only, whereas the other was taught through radiovision plus follow up

discussion method. Only two groups of girls were used; one of these two groups constituted the control group, whereas the other was the experimental group. These groups were also matched with respect to socioeconomic status and intelligence. In the case of the girls, a third group could not be formed because of lack of students. Besides this, no attempt was made to compare performance of boys and girls taught through radiovision because these groups could not be matched.

76. The multifaceted system of evaluation evolved in the pilot phase of the project was used for evaluating radiovision programs experimented with in the final phase. The measures of evaluation included the same tools and techniques with certain modifications done on the basis of results of the pilot phase.

77. Out of the eight experiments on male students, three yielded significant results and demonstrated that the mean gain scores of experimental groups were significantly higher than the groups receiving instruction through the traditional method. In the case of the program "Do Charanko Ka Medhya Rakhey Asamtaye" the group receiving instruction through the traditional method performed significantly better than the experimental groups. Groups receiving instruction through radiovision plus follow-up performed significantly better in the units on (i) "Parmanuka Moolbhoot Kana Va Parmanu Sanrachna" and (ii) "Puspa Va Uske Bhag". The results suggested that radiovision with follow-up could be a more effective instructional system. It may be because of the fact that follow-up provided one more chance for the students to involve themselves in the learning encounter.

78. The results of the experiments with girls revealed that the experimental groups in the three radiovision programs, viz., "Visva Va Seur Mandal", "Pamanu Ka Moolbhoot Kana Va Parmanu San Rachna" and "Puspa Va Uske Bhat", performed significantly better than their counterparts. Similar results were demonstrated in the experiments with boys.

79. On the basis of the results cited above, the conclusion may be drawn that radiovision can be an effective system of instruction for students of Hindi-medium schools. With the experience on the part of the practitioners and improvement in the quality of the programs, radiovision might bring about encouraging results. Future researchers could assess inclusion of a workbook in the radiovision package and probe into the effectiveness of the modified form of radiovision.

80. Results of the program structured interviews, observers' profiles and attention profiles indicated that students liked the radiovision method of instruction. The program in general attracted and held the attention of the students throughout the presentations. Teachers attached high ratings to the importance of the instructional objectives formulated and their achievement. Experts' judgements revealed that they were happy with the quality and appropriateness of the program.

81. Out of the 34 experiments conducted with the help of 14 radiovision programs in 25 comparisons, it was observed that the radiovision group performed significantly better than their counterparts on the criterion test. These findings suggest that radiovision could be fruitfully used as an instructional system in the formal situation. This observation might suggest some concrete solutions to the recurring shortage of teachers. The radiovision programs evaluated in this study covered three branches of knowledge, i.e., social sciences, physical sciences and biological sciences. This further suggests that radiovision as a system of instruction could be used for all disciplines. The experiments also demonstrated that the radiovision programs tested under this project attracted and held the attention of the students to a very high degree throughout the program. This might suggest that the proposed system could be used to deal with the problems of motivation inside and outside the classroom. The results of the study likewise revealed that a positive attitude on the part of the teachers was observed regarding the use of the program. This experiment should be tried out in nonformal education settings so that its use could be extended to out-of-school education programs. At the same time none of the programs was found to produce nonsignificant results in all three languages. At this stage one can ask: "Why did none of the programs produce significantly different results in all the three languages or vice-versa?" This question ends this multidimensional analysis because radiovision is a complex multi-media system which includes many elements like sound, volume, voice and its clearness, structure of lesson, contribution of languages, visual images and other factors which contribute to variance. Besides this, in all three experiments, i.e., Hindi, English and Gujarati, samples differed from each other in terms of environment, learning experiences and so on. Furthermore, production of sound tapes in different languages cannot be said to be of equal standard. Taking into account all the variables, one can say that the combination of some or other variables did not allow the programs to demonstrate significant or not significant differences in all the three languages.

B. Development and Evaluation of Radiovision as an Instructional System (Oberoi, 1981)

82. This was the second major study in the area of technologies of instruction. The study was undertaken with the primary objective of exploring the effectiveness of the radiovision system of instruction. The major areas of concern were comprehension, attention and appeal, and fulfillment of objectives. This study was limited to formal classroom situations. The study was conducted in two phases -- the pilot and the final phase. The final phase included both the main and replication experiments. The experiment was conducted in Hindi language. Government Boys' and Girls Secondary Schools of Dausa in Rajasthan participated in the experiment. In all, 725 students of class IX participated in the study. A multifaceted system of evaluation was designed and developed for evaluation of radiovision. The battery of

evaluative tools included: (i) criterion test; (ii) students' structured interview schedule; (iii) teachers' questionnaire; (iv) attention measures; (v) observers' class profile; and (vi) experts' judgement. Thus, it is obvious that the evaluation of radiovision was not limited to the comparison between experimental and control groups in terms of performance of students on the criterion test. Two radiovision programs, viz., "Solar System" and "Fundamental Particles of Atom and Atomic Structure" were developed for experimentation. For analysis and interpretation of the data, both descriptive and inductive statistics were used and "F" test, "t" test and Sheffe procedures applied to test the significance of these hypotheses.

1. Pilot Experiment

83. Three matched groups of boys were developed for the pilot experiment. In the case of the radiovision program "Universe and Solar-System", the mean gain scores obtained by the three boys' groups working under three experimental conditions were found to differ significantly at .01 level. The radiovision groups obtained significantly higher mean gain scores than the group taught through the traditional method.

84. The girl students receiving instruction through radiovision in the case of both the lessons (i) "Universe and Solar-System" and (ii) "Fundamental Particles of Atom and Atomic Structure" obtained significantly higher mean gain scores on the criterion test as compared to their counterparts receiving instruction through the traditional method. The mean differences were found significant at .01 level.

85. The results of the three boys' groups receiving instruction on "Fundamental Particles of Atom and Atomic Structure" under three experimental conditions revealed that the mean gain scores obtained by three groups differed significantly. "F" value was found significant at .01 level. Radiovision plus the follow-up group obtained the highest mean gain scores whereas the traditional method group obtained the lowest.

86. An analysis of ratings provided by teachers regarding importance and achievement of instructional objectives stated for the two lessons revealed that the majority of teachers were of the opinion that almost all the objectives specified for these lessons were of "high" importance and could be achieved to a "high" degree. The majority of the teachers also said that they would like to teach these units through radiovision if they were to teach the units again.

87. The end of the program interview in the case of both the boys' and girls' groups revealed that good comprehension of instructional points involved in the lesson was achieved by the students participating in the experiment. The boys' group demonstrated better performance as compared to the girls' group.

88. A study of Attention-Profiles of boys' and girls' groups revealed that the radiovision presentation could attract the attention of a great majority of the students from both the groups and could sustain their attention throughout the presentations. When the attention profile of boys groups were compared with the attention profile for the girls group, it was found that the radiovision program involved attention of a comparatively higher percentage of boy students as compared to girl students.

89. Experts' judgements revealed that both the programs, viz, "Universe and Solar system", "Fundamental Particles of Atom and Atomic Structure" were of average standard from the point of view of quality of production. The experts found both the programs satisfactory from the point of view of language and structure of the lesson. They were not satisfied with the quality of graphics and the quality of the sound tape. They suggested that the program needed certain modifications.

2. Final Experiment

90. The two radiovision lessons (i) "Universe and Solar System" and (ii) "Fundamental Particles of Atom and Atomic Structure", were revised in the light of the findings of the pilot experiment and used for the final experiment. In the final phase, experiments were replicated to establish reliability of the results.

(a) Boys' Group

91. The programs (i) "Universe and Solar System" and (ii) "Fundamental Particles of Atom and Atomic Structure" were tried under seven experimental conditions, viz: (i) radiovision with black and white slides, (ii) radiovision with black and white slides plus follow-up, (iii) radiovision with black and white slides plus workbook, (iv) radiovision with colored slides, (v) radiovision with colored slides plus workbook and (vi) the traditional method. The major findings are reported in the following paragraphs.

92. The seven groups receiving instruction under seven different experimental conditions achieved significantly different mean gain scores on the criterion test. The "F" value was found to be 26.88 which was significant at .01 level.

93. Sheffe's test was used to follow-up "F" results. The results indicated that all radiovision groups performed significantly better on the criterion test as compared to the control group. In the case of all the six comparisons, the mean differences were found to be significant at .01 level.

94. Colored radiovision plus workbook and colored radiovision plus follow-up groups obtained significantly higher mean gain scores as compared to the groups receiving instruction through black and white radiovision. In both cases, the differences were significant at .01 level.

95. The seven groups working under different experimental conditions were found to differ significantly from each other in terms of mean gain scores on recognition, recall and comprehension tests. The "F" values were found to be 13.69, 13.07 and 7.45 respectively which were significant at .01 level.

96. The Sheffe procedure revealed that six radiovision groups obtained significantly higher mean scores on recognition test as compared to the group receiving instruction through the traditional method. In the case of all six comparisons, the mean differences were found to be significant at .01 level.

97. In the case of scores on recall test, the group receiving instruction through colored radiovision plus workbook obtained significantly higher mean scores than the remaining five groups excluding the group receiving instruction through colored radiovision plus follow-up. Furthermore, the colored radiovision plus follow-up group obtained significantly higher mean gain score on the recall test as compared to the group receiving instruction through the traditional method. All these differences were found significant at .01 level.

98. With regard to mean scores on the comprehension test, it was found that all the radiovision groups obtained significantly higher mean gain scores than the group receiving instruction through the traditional method. Out of the six comparisons, five were found significant at .01 level whereas the difference between the mean gain scores of black and white radiovision group and traditional method group was significant at .05 level.

Replication

99. This experiment was replicated on seven groups of male students of class IX formulated on a similar criteria to validate the findings of the study. Results of experimental conditions were found to differ significantly in terms of mean gain scores on criterion test. The "F" value was found to be 27.17 which was significant at .01 level. Radiovision with colored slides plus workbook obtained the highest mean gain score whereas the mean gain score was lowest in the case of the group receiving instruction through the traditional method.

100. When the mean gain scores were compared in terms of recognition, recall and comprehension, significant differences were observed. The "F" values were found to be 45.2, 14.65 and 9.45 respectively which were significant at .01 level.

101. The Sheffe procedure revealed that all the radiovision groups except the black and white radiovision group obtained significantly higher mean gain scores as compared to the group receiving instruction through the traditional method and black and white radiovision only.

102. The results of the Sheffe procedure with regard to mean gain scores on recognition test revealed that the colored radiovision group performed significantly better than the groups receiving instruction through black and white radiovision and traditional methods. Mean differences in both cases were found significant at .05 level. In the case of the remaining 19 comparisons no significant differences were observed.

103. In the case of scores on the recall test it was observed that the group receiving instruction through colored radiovision plus work-book obtained significantly higher mean scores on the criterion test as compared to the remaining six groups receiving instruction under six different experimental conditions. All these differences were significant at .01 level.

104. With reference to comprehension scores, it was observed that the groups receiving instruction through different systems of radiovision except the group receiving instruction only through black & white radiovision obtained significantly higher mean gain scores on the criterion test as compared to those receiving instruction through the traditional method. Furthermore the groups receiving instruction through colored radiovision plus workbook and colored radiovision plus follow-up obtained significantly higher mean gain scores as compared to the group receiving instruction through black and white radiovision. In the case of the remaining 14 comparisons no significant differences were observed.

(b) Girls' Group

105. Three groups were formed, the main experiment and the two radiovision programs which were used for boys' groups were also used for the girls' group to keep the content constant. The treatments were traditional method, black and white radiovision and colored radiovision. The major findings of the experiment were as described in the following paragraphs.

106. The three groups working under three different experimental conditions obtained significantly different mean gain scores on criterion test. "F" value was found to be 40.73 which was significant at .01 level. The colored radiovision group obtained the highest mean gain scores whereas the control group obtained the lowest.

107. The mean scores of the students working under three different experimental conditions were analyzed in terms of recognition, recall and comprehension. The mean gain scores in the case of recognition and comprehension differed significantly and the differences were found significant at .01 level. In the case of recall the "F" value was found not to be significant.

108. The Sheffe procedure was used for the follow-up of "F" results. It revealed that both the radiovision groups performed significantly better on the criterion test as compared to the group

receiving instruction through the traditional method. The difference was found significant at .01 level.

Replication

109. Three new matched groups of female students were formulated for replicating the experiment. The three groups of girls working under three different experimental conditions produced significantly different results in terms of mean gain scores on criterion test. The "F" value was found to be 33.99 which was found significant at .01 level. The colored radiovision group obtained the highest mean gain scores (17.00) whereas the traditional method group obtained the lowest (7.73).

110. When the performance of three groups were compared with reference to recognition, recall and comprehension, the groups were found to differ significantly in the case of recognition and comprehension. The obtained "F" values were 47.45 and 18.99 respectively, which were found to be significant at .01 level.

111. The Sheffe procedure was used to follow up the "F" results. In the case of comparisons in terms of total gain scores on the criterion test, the colored radiovision group obtained a significantly higher mean gain score than the traditional method group and black and white radiovision group. Mean differences in both cases were found significant at .01 level. Similar results were observed in case of mean scores on recognition and comprehension. Thus it could be concluded that in the case of girls' groups, colored radiovision consistently produced significantly better results when compared to the remaining two methods of instruction.

112. Ratings of the majority of teachers, working with different radiovision groups (both boys and girls), indicated that the objectives set for the two radiovision lessons were highly important. The ratings regarding achievement of these objectives revealed that the majority of the instructional objectives could be achieved to a great extent. A large majority of the teachers said that they would like to use radiovision if they were to teach these lessons again.

113. The attention profiles of different radiovision groups (twelve boys and eight girls) indicated that radiovision could attract the attention of a very high percentage of students and sustained their attention throughout the presentations.

114. The results of the end of the program interview and observers' profile revealed that good comprehension of the learning points involved in the lesson was achieved on the part of the students participating in different radiovision groups. Students' achievement improved when radiovision instruction was followed by group activity or a workbook when introduced in the radiovision system of instruction.

C. Relationship between Selected Instructional Methods, Achievement in Science and Pupil Groups Designed as High, Medium and Low Achievers (Tripathi, 1982)

115. The major objectives of this study were: (i) to provide data on the efficacy of radiovision, programmed learning and peer-tutoring as instructional methods; and (ii) to examine the comparative effectiveness of radiovision, peer-tutoring, programmed instructions and traditional methods of instruction. This has been an experimental study. Students of IX class of Government Higher Secondary School, Malpura and Bhawani Neketan Higher Secondary School, Jaipur were selected for the purpose of the pilot and final phases of the study. A random sample of 75 students was taken for the pilot study whereas the sample for the final experiment constituted 160 students. In the final phase, 160 students were randomly assigned to four treatments: (i) radiovision; (ii) programmed instruction; (iii) peer-tutoring; and (iv) traditional instructional method. A multifaceted approach of data collection consisting of: (i) criterion tests; (ii) end of radiovision program structured interview; (iii) teachers' questionnaire; (iv) attention profile; (v) observers' class profile; and (vi) expert judgement were used. The topic "Reproduction and Growth" was used as content of teaching and produced in the forms of radiovision, programmed instruction and peer-tutoring lesson. Both the quantitative and qualitative statistics were used for analysis and interpretation of data. "T" test and "F" test were used for testing the significance of mean differences. Attention profiles provided data regarding attention and appeal on the part of the students. The findings of the study were as follows:

(i) The difference between mean gain scores of the students receiving instruction through different methods of instruction, viz., radiovision, programmed instruction, peer-tutoring and traditional instructional methods were indicative of real differences.

(ii) The performance of the students receiving instruction through radiovision was significantly higher than the students receiving instruction through the traditional instructional method. However, the performance of the radiovision group was not significantly higher than the group receiving instruction through the programmed instruction.

(iii) The performance of the students of the radiovision group was not higher as compared to the performance of the students of the peer-tutoring group.

(iv) The performance of students of the programmed instruction group on the criterion test was significantly higher as compared to the students of the traditional instructional method.

(v) Peer-tutoring group performed better in terms of mean gain scores than the traditional instructional group.

(vi) The performance of the students after receiving instruction through radiovision on the criterion test was significantly higher compared to pre-treatment performance.

(vii) The majority of the teachers expressed the view that the objectives set for the radiovision lesson were very important.

(viii) The attention profiles revealed that radiovision attracted the attention of a very high percentage of students who sustained it throughout the presentation of the program.

(ix) The experts' judgement opined that the quality of the program was very satisfactory. The program could achieve its instructional objectives and could serve as an effective stimulus.

(x) The performance of the high achievers under different experimental treatments was found to be different.

(xi) The performance of the radiovision group of high achievers was significantly better in terms of the mean gain scores as compared to the traditional instructional group of high achievers.

(xii) The performance of the radiovision group of high achievers was not significantly better than the performance of the peer-tutoring group of high achievers.

(xiii) The performance of the four groups of medium achievers under different experimental conditions did not differ significantly in terms of mean gain scores.

(xiv) The performance of the low achievers under different experimental treatments differed significantly.

(xv) The performance of the programmed instruction group of low achievers was better than the performance of the traditional group of low achievers in terms of mean gain scores.

116. On the basis of the analysis of these findings, one can conclude that all the three experimental instructional methods produced comparatively high mean gain scores as compared to the traditional method of instruction. The experimental methods when compared with each other in terms of the performance of the students, did not produce any significant difference. Two clear inferences can be drawn on the basis of this analysis. First, all the three experimental methods, viz., radiovision, programmed instruction, peer-tutoring were found to be significantly better than the traditional instructional method. And

second, they were equally effective. This should provide greater scope to the practitioners for the selection of alternative methods of instruction.

IX. EDUCATIONAL IMPLICATIONS

117. The increasing number of school-age children needing education is attracting the attention of educational technologists, especially in the developing countries. The material and human resources are limited. Now the problem is how to meet the educational needs of the disadvantaged groups as well as improve the quality of education, keeping in mind the advancement in the area of knowledge and technologies. This situation warrants an integrated approach specially with reference to instructional methods and technologies of instruction. Besides this, the need of the day is optimal utilization of mass media, involving proper use of strategies of individualized instruction. This could help in meeting the challenges of both the quantitative and qualitative aspects of the problem. In view of the constraints of the finances available, the researchers must design instructional systems which are cost-effective. If this proposition is accepted then we have to make it clear that the mass communication media (especially radio) can play an important educational function to meet the quantitative aspect of the problem. The problem boils down to the point of how to use this medium to provide effective instruction. One can learn a lot of experiences from the studies on television in this respect. The utility and effectiveness of radio broadcasts could be extended greatly by converting it into radiovision.

118. The findings of the studies reported earlier suggest that radiovision could be fruitfully used as an instructional system in a formal situation. The radiovision approach could help in meeting the problem of shortage of teachers as well as in fruitful utilization of time of students (through peer-tutoring) when the teacher is absent for one reason or another. This system could help in solving the problem related to motivation and attention on the part of the students. This would indirectly help in the minimization of dropouts. Radiovision could be an appropriate method for developing active and critical educational programs and minimizing dropout rates. To conclude, the findings of these studies also suggest that there is a lot of scope for experimentation in the area of instructional technologies, which might result in providing data to practitioners for identifying alternative methods of instruction as per needs of the situation.

119. Beyond the classroom, radiovision can be utilized to assist developing countries in tackling real problems relating to the lack of quality teachers and the provision of educational services to remote rural areas. Quality teachers are usually employed in city-based schools which have resources to be able to afford their services. Radiovision allows the filming of teachers' lectures, the taping of their talks and discussions, and the combination of both in inexpensive

technology so that these can be brought to rural-based disadvantaged classrooms. The same content, the same methodology, the same vigor and enthusiasm of such excellent teachers can be captured on tape, supplemented with slides, so that they can be made portable and brought to poor schools in rural areas

120. Coming to peer-tutoring, one will find that besides its effectiveness as a teaching method it can help in meeting the social and emotional needs of the students. This strategy does not require a great deal of sophisticated resources but emphasizes optimal utilization of available human resources. Teachers might use this approach for qualitative enrichment of their classroom instruction as well as remedial teaching. As it is cost-effective, it could be very useful for communities and nations lacking resources. Peer-tutoring strategies could be further strengthened with the help of the radiovision system.

121. It is important at this point likewise to consider the cost-effectiveness of radiovision as a key strategic instructional medium for use by developing countries to service vast number of poor students and whole populations. This is only proper since less-developed countries (LDC) governments are hard-pressed for resources which are relatively scarce. The potential for mobilizing more funds is limited by the low level of development. Every year, the budget for education is almost always insufficient given the goals and objectives that must be achieved to meet minimum standards of literacy and functional skills needed by students and citizens. And inevitably, in examining the budgets of LDCs, education always appears to take the largest share of expenditures compared to other social and economic endeavors.

122. Of the various educational technologies available to the teacher, radiovision could emerge as his most efficient aid in the grassroots, serving as a technology for the poor. Furthermore, in the different studies undertaken on distance education, and the multimedia and various techniques used to deliver distance education, such as print materials, radio, TV, audio-video cassettes, kits, etc., TV has been found to be among the most expensive and radio among the least expensive, almost 1/10 of TV. If we are to add to the radio component the tape-slide element, which probably amounts to even less, then one can readily see that the actual cost of radiovision is small compared to the full use of TV or audio-video cassettes. When added to the findings on the cost per student of distance education systems (averaging from only 1/4 to at most 1/2 of the cost of traditional college or university education in the formal schooling system) then certainly my advocacy of radiovision as the teacher's best and most efficient and cost-effective technology tool in the classroom should merit very serious consideration. The time of the educational technologist of the 1990s is now -- and radiovision could be the trigger mechanism to bloom the classroom teacher into one -- a quantum leap from blackboard/chalk technology to the technology of radiovision.

123. In sum, these scientific and elaborate researches point to very strong justifications for the widespread use of appropriate educational technology, such as radiovision, in aid of the classroom teacher in the learning process. It has been demonstrated that radiovision is a congenial medium, allowing students to manipulate its tempo and pace according to his own needs and competence. It brings sight and sound together so that the teacher can expand the instructional process in the simple confines of a classroom. The tape-slides offer a variety of visual possibilities, both in black and white and much more effectively in color. The audio-cassettes allow the best teachers in given subjects in a country/province to conduct lectures for students, to be followed up by sessions with the classroom teacher. All of this become even more effective when teachers' and students' workbooks are used consistent with the lesson plans. Finally, if select students are mobilized to serve as peer-tutors, the radivision assumes a credibility and touch of intimacy that hard media like TV or radio by themselves cannot reach. Many subjects are therefore easily handled through radivision and can temporarily substitute for the teacher when he is away for short periods of time. Least expensive, its further packaging into portable kits combining audio cassettes, tape-slides and slide projector, could be a very important technology for the countryside.

X. ECONOMICS OF RADIOVISION

124. Governments of developing countries have virtually reached their ceilings in the provision of budgets for educational expenditures covering not only basic education but also higher education and technical/vocational education. Investments in physical facilities and equipment are at a standstill and financing of quality improvements, such as in teacher-training, textbook production, and curriculum developments are going at a turtle pace. Yet the demands for education continue unabated, and new students are bound to create even bigger problems in physical accommodation in the traditional universities in terms of classrooms, full-time teachers, and the required auxiliary costs of transportation, meals, clothing and other personal expenses to attend fixed-hours of classroom attendance. As a percentage of the total government budget and of GNP, the educational expenditures incurred by LDC governments are hardly able to match the UNESCO recommendations that they comprise 15 per cent of total budgets and 5 per cent of GNP. Most are quite way below these norms.

125. This is why many developing countries have turned to distance education, not only as a route to supplement and complement traditional formal schooling, but as an alternative or separate path to the attainment of education and training. Other than the quality that distance education has attained in such countries as the United Kingdom, Japan, Thailand, and others, its greatest attraction is the cost-effectiveness of its systems. Yet as a whole, distance education universities or institutions/programs in distance education receive an extremely low percentage of educational budgets. As an example, in 1985

the government of Thailand allotted to Sukhothai Thammathirat Open University an amount equal to only 1.3 per cent of the total budget for Thailand's higher education institutions -- yet the total number of students admitted by the Open University of Thailand was three times the number admitted by all traditional conventional universities combined in that country.

126. Most open university institutions allocate a large portion of their budgets to the following primary items: (i) main media, such as correspondence texts, textbooks, workbooks, radio and television broadcast handbooks, etc.; (ii) support media such as radio and TV broadcasts, including broadcasting of videotapes and course materials recorded on cassette tape; and (iii) tutorial and counselling sessions at various regional and local study centers.

127. As a whole, distance education clearly demonstrates its cost-effective advantages over traditional conventional colleges and universities, e.g.: (i) in China, the estimate is that 200-300 yuan is needed per year to train a correspondence student at college level, compared to 5,000 yuan needed to train a student of three-year professional training in the traditional colleges; (ii) in Sri Lanka, the cost is estimated to be less than one third of the conventional universities irrespective of the basis on which the comparison is made; (iii) in Korea, the Korea Air and Correspondence University has an average cost of one tenth of the average cost per student at the nation's conventional universities; (iv) in Pakistan, costs of educating students in professional programs at the Allama Iqbal Open University are 45 per cent only of the costs of traditional institutions; and (v) in Thailand, costs per student at the Sukhothai Thammathirat Open University are very much lower than that of conventional universities, making up from only 5 per cent to 15 per cent of such annual costs. The picture is even more enlightening when it comes to the calculation of the private costs of education. Distance education university provides home-based education and therefore the students' personal expenses (such as housing, travel, food, clothing, etc.) are much less than those of the students at conventional institutions.

128. Coming to particular medium used, the costs for each medium in each institution of each country will naturally vary from program to program and organization to organization. It is difficult to isolate the costs only for radio or only for television, for example, as the distance education approach of most countries is multimedia. But one good example of the cost-effectiveness of radio and TV is Japan's University-of-the-Air Foundation, which utilizes radio and TV as major components of its multimedia approach, and not correspondence text alone. In analyzing the economics of TV-supported education of the University of the Air, it was estimated that the cost per student per annum of the University of the air was from US$1,500 to US$2,000, as compared to US$13,700 to US$14,000 for a student in a conventional traditional Japanese university. Similarly, it has been estimated that television is the most expensive medium and that radio is one tenth of

the cost of TV. These estimates, and the previous statistics cited, are contained in the Asian Development Bank publication "Distance Education", in two volumes.

129. As to radiovision, the cost estimate must be done deductively. In addition to the radio cost (presuming that radio broadcasting can be integrated into a radiovision program as a regular medium, and that it is one tenth of the cost of TV) radiovision would require tape-slides the costs of which will vary according to the number and types required, and the standard slide projector and cassette player. Further studies must be made to apply the rigor of systemic efficiency to such medium as radiovision. This would involve primarily: (i) internal efficiency, that is, the cost-effectiveness in the use and management of radiovision, the minimization of waste and optimization of results and use of scarce resources; and (ii) external efficiency, that is, the useful applicability of this medium to the students' entry to higher levels of education, inevitably to the world of work and employment. Basically, therefore, radiovision comes as a compact kit: a cassette, an audio-cassette to play the main lectures, slides, slide projector, and any white wall in any building or classroom to serve as screen. The kit can be carried by hand anywhere in the rural villages, operated by batteries without need for electricity, except for the use of the slide projector (now battery-operated slide projectors are also available). It is in effect a "walking classroom of appropriate technology" where students can have access to audio-visual facilities in support of the teacher's instructional system. It represents possibly the most inexpensive package of audio-visual technology. Further development of a complete battery-operated systems should be pursued so that any village without electricity in any part of any developing country can be exposed to radiovision.

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